

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION 8



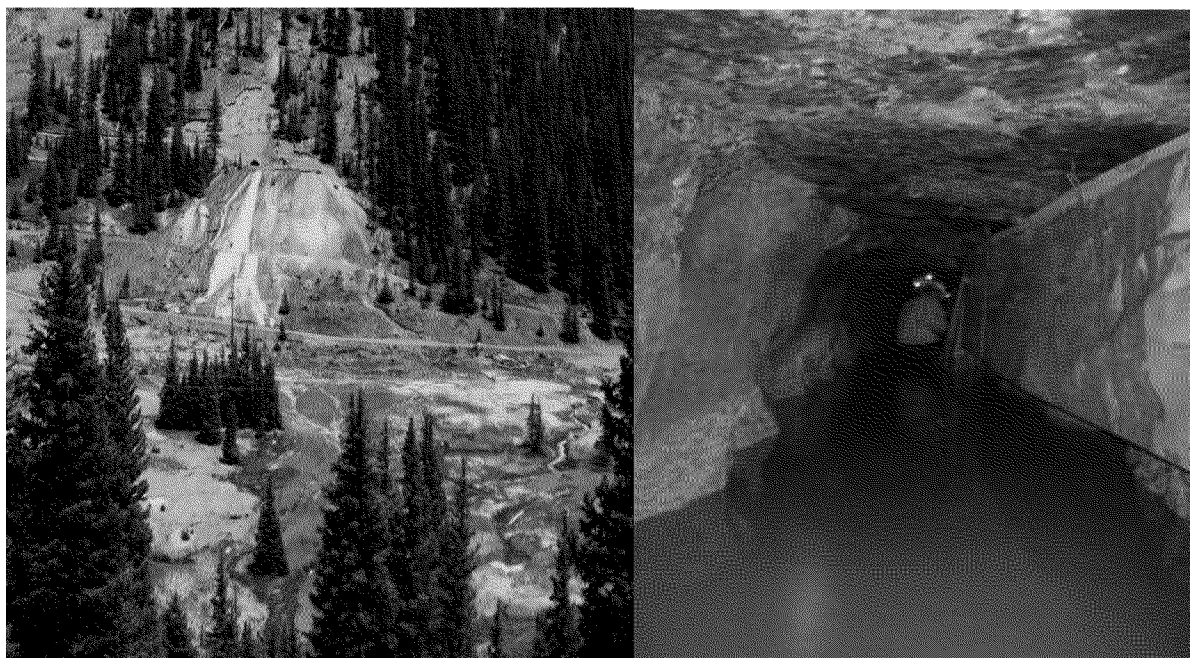
**Subject:** POLREP #4 (Progress Pollution report)  
Red and Bonita Mine Site  
Site #  
Silverton, CO  
Latitude: 37.8972 Longitude: -107.6441

**To:** Laura Williams, Response Unit Chief  
David Ostrander, Program Director

**From:** Steven Way, On-Scene Coordinator

**Date:** September 25, 2014

**Reporting Period:** December 2013 to September 2014



## 1.0 INTRODUCTION

### 1.1 Background

Site Number:	08UP	Contract Number:	
D.O. Number:		Action Memo Date:	9/2/2014
Response Authority:	CERCLA	Response Type:	Time-Critical
Response Lead:	EPA	Incident Category:	Removal Assessment
NPL Status:	Non-NPL	Operable Unit:	OU 3
Mobilization Date:	8/11/2014	Start Date:	9/3/2013

<b>Demob Date:</b>		<b>Completion Date:</b>	
<b>CERCLIS ID:</b>	MT0001096353	<b>RCRIS ID:</b>	
<b>ERNS No.:</b>		<b>State Notification:</b>	
<b>FPN#:</b>		<b>Reimbursable Account #:</b>	

### **1.1.1 Incident Category**

CERCLA Removal Assessment

### **1.1.2 Site Description**

The Red and Bonita Mine is located within the Cement Creek watershed, a component of the upper Animas River watershed in San Juan County, Colorado. These watersheds within the volcanic terrain of the San Juan Mountains were the focus of both large and small-scale mining operations that flourished beginning in 1871 and lasted until as late as 1991. Historic mapping of the Red and Bonita Mine indicates that it was advanced predominantly prior to 1899. Mining operations lasted a short period, but no activity occurred after the initial operations. Several other mines in the Cement Creek basin also have draining adits. The flow from the Red and Bonita Mine, the Gold King (Level 7) Mine, and the Mogul Mine all experienced significant increases in flow following the plugging of the American Tunnel that occurred between 1998 and 2002. Water quality in the Animas River has been degraded progressively since that time.

The Animas River and many of its tributaries, including Cement Creek, carry high concentrations of metals from both acid rock/mine drainage at mine sites and from natural sources not impacted by mining. Water quality studies have indicated that the Red and Bonita Mine is one of the major sources of metals to the Animas River near Silverton.

The EPA, BLM and USGS have undertaken activities to more fully quantify the various mine site sources and to quantify diffuse metals sources within the mine district that contribute to the metals loads in the Animas River. These actions are intended to contribute to the information needed to identify potential remedies to reduce or prevent the ongoing hazardous substance (metals) releases from the mine sites.

The Red and Bonita Mine consists of approximately 1.25 acres of waste rock and suspected tailings material, and an estimated 3,000 foot long adit that drains approximately 300 gallons per minute throughout the year. The mine water discharge occurred through a collapsed rock debris blockage for an unknown number of years. A new portal structure was installed in October 2011 after removing a 30 foot blockage at the adit entrance. Adit discharge flows across the top of a mine dump and approximately 200 feet down the dump face before being channelized at the toe of the dump. The channel directs flow into an iron bog en route to Cement Creek approximately 500 feet down gradient of the toe of the dump. The mine site lies east of Cement Creek on a west-facing mountainside slope with an average 44 percent grade. The mine is accessible during non-snow months of the year, typically late June through early October. The mining claims associated with this mine are on steep terrain and create limiting conditions for operations. The site is seasonally inaccessible due to snow and extreme weather conditions.

#### **1.1.2.1 Location**

The Red and Bonita Mine Site is located in San Juan County, Colorado. The portal is approximately 7 miles north of the town of Silverton, Colorado, at 10,893 feet above mean sea level (AMSL). Road access is via County Road (CR) 110 from the town of Silverton to CR53 at the abandoned town site of Gladstone. CR53 continues northward up the Cement Creek valley to the mine site, approximately 0.5 mile north of Gladstone.

#### **1.1.2.2 Description of Threat**

Since 2005, adit discharge rates have been observed to be increasing from approximately 200 to 300 gpm. The pH of discharge water typically averages 6.1 standard units (su) but goes as low as 3 to 4 su. The adit discharge water contains high concentrations of several metals that include: total aluminum (4,000 parts per billion (ppb)), cadmium (35 ppb), iron (90,000 ppb), lead (60 ppb),

manganese (34,000 ppb), and zinc (16,000 ppb). The discharge from the adit represents a significant release of the heavy metals including zinc to the Animas River.

The results of a Screening Level Ecological Risk Assessment (February 2013) strongly suggested that the fish community in the Animas River at and below Silverton would experience high stress under current conditions. For example, the surface water hazard quotient for zinc in the Animas River below the confluence with Cement Creek is approximately 4, which is four times the expected no-effects level. In addition, the study identified aluminum, copper, lead, and zinc as the major risk drivers to insectivorous birds ingesting surface water, sediment, and aquatic invertebrates from the Animas River at and below Silverton. Metal concentrations measured in the substrate of the Animas River at and below Silverton were expected to be highly toxic to benthic invertebrates. Recent fish population studies conducted by the Colorado Division of Wildlife found no fish in the Animas River below Cement Creek for approximately 2 miles.

### 1.1.3 Preliminary Removal Assessment/Removal Site Inspection Results

Initial removal assessment investigations of the Red and Bonita Mine in 2010 were focused on characterizing the discharge from the collapsed adit and determining if a significant contribution of metals to the discharge occurs as water flows over and through the waste dump. The investigation findings showed that there was relatively little addition of metals to the adit discharge water from the waste dump. Mine water drainage flows from the adit over the mine dump face at approximately 300 gpm into Cement Creek. The Cement Creek confluence with the Animas River is approximately 7 miles downstream at the town site of Silverton.

In an effort to characterize the hazardous substance releases in the watershed, the surface water and mine adit discharges were sampled by EPA several times during the year over several years. It is now sampled two times each year (spring and fall) at established locations for water quality parameters, flow volume, and total and dissolved metals in Cement Creek and the Animas River by the EPA Environmental Services Assistance Team (ESAT). ESAT also performs laboratory analysis and data reporting to the SCRIBE network.

**Mine Adit Discharge 2005 to 2011**

Mine	Elevation (feet AMSL)	Bulkhead Install	Flow Rate (gpm)				
			July 2005	September 2005	October 2006	Average 2010	Average 2011
Red and Bonita	10,893	None	210	224	233	216	319

gpm – gallons per minute      AMSL – above mean sea level

## 2.0 CURRENT ACTIVITIES

### 2.1 Operations Section

#### 2.1.1 Narrative

The objective of the removal assessment is to determine actions needed to reduce the flow of contaminants from the Red and Bonita Mine to Cement Creek.

#### 2.1.2 Response Actions to Date

##### 2011 Mine Entry

A new mine portal structure was installed in October 2011 after removal of a 30 feet blockage at the adit entrance. Filter bags were used to collect solids discharged from the mine during 2011 site work.

##### 2012 Mine Entry

A mine entry was performed in June 2012 to investigate and map the Red and Bonita Mine workings. The rock structure and water sources entering the workings were evaluated to determine the potential for implementing hydraulic controls. The underground assessment work was performed by a team including mining engineers and a geologist with the Colorado Division of Mining, Reclamation, Mining, and Safety (DRMS), supported by EPA.

The mine adit is approximately 6 feet by 6 feet and extends underground for an undetermined length; based on historic information and the estimated waste dump volumes it is estimated to be approximately 3,000 feet of underground workings. During the entry in 2012, the first 680 feet was verified to be open without blockages/collapses and to be within a competent andesitic rock requiring little to no support. The portal structure was built into a ferricrete mass entering the adit, also mostly competent.

Underground investigations revealed an abundant accumulation of yellowboy to the 680 foot distance that was investigated. The yellowboy accumulations varied in thickness from 0.5 feet to 3 feet. The mine entry was terminated at 680 feet inby because yellowboy solids that were disturbed by the entry team and crews placing ventilation bags caused the water filtration system to reach its maximum capacity to filter the suspended solids. The extent and depth of the precipitate contributes to waist-deep mine drainage water in some areas, rendering mine entries very difficult.

A water inflow of approximately 10 gpm was observed from a small drift located at approximately 283 feet inby, while the remainder of the approximate 300 gpm flow was from beyond 680 feet inby.

Air inside the adit was oxygen-depleted in 2011 and 2012, and active ventilation was required to allow for safe entry by personnel going beyond the initial 50 feet. Ventilation in the mine was accomplished by installing "lay-flat" flexible vent bags and using a fan to blow outside ambient air into the mine. Lay-flat vent bag was left intact in the mine adit from the portal to 200 feet inby.

A water management system was constructed to control the release of solids mobilized by the mine entry; however, water was not treated to reduce dissolved metals concentration normally present in the acid mine discharge. Filter bags were used to collect the solids. The filter bags were dried and sampled and the spent filter bags, containing an estimated 5 to 7 tons of mine drainage filtrate including those stored at the site since 2011, were transported to the Bondad Landfill in Durango, Colorado, for disposal in July 2012. Following the entry in June 2012, it was determined that additional water management capacity was necessary to control the discharge of the yellow-boy/metals precipitates during future mine entries.

Subsequent to the entry in June 2012, the owner of the adjacent property agreed to allow access to construct a settling pond to assist in capturing the solids in the discharge water. The area was evaluated prior to pond construction. Mill tailings with elevated metals were identified on the ground surface, possibly from a stamp mill that operated at the mine. Samples from surface and depth showed metals present including iron at 437,000 to 444,000 mg/kg, lead at 1,500 to 1,800 mg/kg, zinc at 1,200 to 1,500 mg/kg, and mercury was detected in the surface sample. The analytical results for the soil were similar to metals concentrations found in the solids filtered from the water during the mine entry. Test pits were dug to determine the depth to groundwater and identify any hydraulic confining layer and to assess wetland properties. In October 2012, a settling pond was constructed within a mining impacted area (on the Success Placer claim) on the west side of the county road.

### **2013 Mine Entry**

The 2013 mine entry was performed to investigate the deeper workings, identify any evidence of a connection to other mines such as the Gold King 7 Level, and further evaluate the rock structure and potential locations for a bulkhead.

A treatability study was performed during the winter to select the appropriate flocculent and determine the buffering requirements to achieve the solids settling rates necessary given the retention time of the pond. The selected flocculent was a chitosan-based material (Liqui Floc),

which is a biodegradable substance, injected at a rate of approximately 0.063 liter/minute. Approximately 0.45 liter/min of a 25% sodium hydroxide solution was needed to raise the pH to a level between 5.5 and 7 to enhance the effectiveness of the flocculent. Adjustments were made in the field to accommodate varying water characteristics during the mine entries.

Prior to the August 2013 mine entry, the water management system was installed. The settling pond was enlarged during 2013 to increase capacity. A piping system was placed to carry water from the mine to the retention pond. A series of media (sand and gravel) filters and canister filters were placed in series to remove the remaining suspended solids from the pond discharge to levels equal to or lower than ambient discharge conditions.

Initial mine entries were performed by Frontier Environmental to assess the conditions in the mine and hang additional ventilation ducting. A pathway was made through the settled solids ( "spooge") that had accumulated to depths of 3 feet. The solids were captured in the piping system and conveyed to the settling pond with the mine discharge water. The discharge water pH dropped from approximately 6 to 3.5 when personnel were underground disturbing the precipitated solids.

On August 13, 2013 the mine workings were assessed by the Colorado Division of Reclamation and Mining Safety (DRMS) and Frontier Environmental. The assessment included a complete mapping of the tunnel / adit workings that included multiple legs (drifts) off the main adit. A collapse and precipitation build-up prevented further entry at approximately 980 ft inby of the portal on the main adit heading. The measured lengths of the open workings that were assessed totaled approximately 2700 feet. The majority of the water flow originated at the end of the blockage at 980 feet inby.

Water was sampled from the water discharged from the pond/filter system during the mine entry and analyzed for total metals concentrations. Analytical results showed that the water management (flocculent, settling pond and filter system) was effective in preventing the release of the suspended solids and preventing an increase in total metals load in water discharged to Cement Creek.



Blockage at approximately 980 feet on the main north trending leg

#### **2014 Mine Entry**

A mine entry was conducted the week of September 8, 2014 for the purpose of estimating the hydraulic conductivity of the rock at a potential bulkhead location. The following work was performed during August and September 2014 to conduct the testing and support the mine entry:

- A treatability study was performed to determine the water treatment actions required to remove solids during the 2014 mine entry. Application rates of flocculant (Brennfloc) and sodium hydroxide to achieve maximum solids settling were tested in settling cones and later in on-site bucket tests. A titration was performed to determine the amount of 25% sodium hydroxide is needed to increase mine water pH to 6 to 7 to enhance flocculant efficiency.
- Settled and dried solids (approximately 10 cubic yards) from previous mine entries were removed from the settling pond and placed in a temporary repository located at the north end of the base of the waste dump. A pipe was installed under CR53 to transport water from the base of the waste dump to the settling pond. Geofabric and hay bales were placed on the baffles to increase settling time and solids retention in the first two segments of the settling pond.
- During the mine entry the adit discharge water was allowed to flow down the face of the waste dump. Sodium hydroxide was injected at the top of the waste dump and Brennfloc was injected at the base of the waste dump. Addition rates were adjusted depending on the amount of solids and stagnant water (low pH from long-term contact with solids in the mine) being discharged from the mine. Water then flowed in an open channel along CR53, through a 12" pipe under the road, and into the settling basin. Water was pumped from the third segment of the settling basin and either discharged directly or through filter bags to the overland channels that flow to Cement Creek.
- A packer test was conducted to estimate the hydraulic conductivity of the rock at the potential bulkhead location, approximately 275 feet in by the portal. The location is outby previously identified water inflows. Packer test methods and equipment were researched, procured, and tested prior to mobilization to the Site. On September 9 and 10, four 11 foot boreholes were drilled into the rock and tests were performed at 1 or 2 depths within each hole, depending on the results of the first test. To conduct each test, the packer was inserted to the selected depth and sealed against the borehole. Water was injected into the hole to 100 pounds per square inch pressure. The pressure was maintained for a minimum of 15 minutes and the amount of water required to maintain the pressure was measured. If a significant amount of water was required to maintain pressure with the packer at the shallower depth in a borehole, the test was repeated with the packer placed further into the borehole to help determine if the permeability occurred primarily in the shallow or deeper segment of the hole.
- DRMS has determined through preliminary analysis of the packer test results that the Red and Bonita adit at the proposed bulkhead location is composed of high-quality rock with very low permeability. Improvement of the rock through formation grouting is unnecessary based on the packer test results.

## **2.2 Planning Section**

### **2.2.1 Anticipated Activities**

- Additional work may be required to complete the hydro-geologic analysis of the mine-workings and bulkhead feasibility analysis.
- Solids present in the mine outby the proposed bulkhead location must be removed to improve access to the potential bulkhead location. "Loose" solids will be stirred up, released from the mine with the adit discharge water, and directed through a piping system to the settling pond system. The water treatment/solids settling system will be designed during the winter. A new pond may be constructed and the baffles within the existing settling pond will be raised to increase retention time.

## **2.3 Logistics Section**

No information available at this time.

## **2.4 Finance Section**

No information available at this time.

## **2.5 Other Command Staff**

### **2.5.1 Community Involvement**

The Animas River Stakeholders Group is actively involved with the work in the watershed and is routinely briefed on the work at the Red and Bonita Mine. The group was formed to improve water quality and habitats in the Animas River through a collaborative process designed to encourage participation from all interested parties. Participants include mining companies, citizens, environmental organizations, land owners, local governmental entities, and state and federal regulatory and land management agencies. Regular meetings are held with the participants.

## **3 Participating Entities**

State of Colorado Division of Reclamation, Mining, and Safety (DRMS), Animas River Stakeholder Group (ARSG), Bureau of Land Management.

## **4 Resources On Site**

The following is a partial list of organizations that participated in performing work at the site for these activities:

- Environmental Protection Agency:
- DRMS
- Bureau of Land Management
- EPA Superfund Technical Assessment and Response Team (START)
- EPA Emergency and Rapid Response Services (ERRS) Contractor, Environmental Restoration
- Frontier Environmental Services Company (FES)
- Maisel Construction
- EPA Environmental Services Assistance Team (ESAT)

## **5 ADDITIONAL SOURCES INFORMATION**

Animas River Stakeholder Group website: <http://www.animasriverstakeholdersgroup.org/>

EPA OSC website: [http://www.epaosc.org/site/region\\_list.aspx?region=8](http://www.epaosc.org/site/region_list.aspx?region=8)